## ANNUAL SUMMARY FOR 1889.

The following general discussion of the weather over the United States during 1889 is based upon seven charts, published herewith, which show, respectively, the annual mean temperature and the departures from the normal temperature; the annual mean atmospheric pressure and the prevailing winds; the absolute ranges of temperature; the maximum temperatures; the minimum temperatures; the annual precipitation; and the departures of the annual precipitation from the annual normal precipitation. These charts have been prepared from data received from about 1,000 regular and voluntary observers of the Signal Service. An index of the MONTHLY WEATHER REVIEW for 1889 is also published herewith.

### TEMPERATURE.

The annual mean temperature was highest in adjoining parts of southeastern California and southwestern Arizona, and in extreme southern Florida, where it rose above 75°; and in the southern half of Florida, at Port Eads, La., in the lower Rio Grande valley, and in the lower Colorado and Gila valleys, mean readings of 70° or above were reported. The mean temperature was above 50° south of a line traced from southern New England irregularly westward to Denver, Colo., thence southward to central New Mexico, thence westward to central Arizona, and west of this line continued northwestward to extreme northeastern California, thence southeastward to central Utah, and thence northwestward to extreme northwestern Washington. The annual mean temperature was lowest in Manitoba, where it fell below 35°, and the mean values were below 40° north of a line traced from the west-central coast of the Gulf of Saint Lawrence westward over Canada and extreme northern Michigan to central Minnesota, and thence west-northwest into the British Possessions north of Montana. The mean readings were also below 40° in an area occupying the more elevated part of west-central Colorado.

The most marked departures above the normal temperature occurred in western Minnesota, North Dakota, north-central Montana, in the British Possessions north of North Dakota and Montana, and on the southwest coast of the Gulf of Saint Lawrence, where they exceeded 3°, and the departures above the normal temperature were 2° or more in Nova Scotia and eastern New Brunswick, in central Pennsylvania, and along the northern border of the country from Minnesota and the eastern part of the Dakotas to northern Idaho. The departures below the normal temperature equalled or exceeded 1° on the coast of eastern Maine, on the immediate south Atlantic coast south of South Carolina, in the Florida Peninsula, at Mobile, Ala., and in central Texas; elsewhere the departures below the normal temperature were less than 1°.

At stations in New England, the middle Atlantic states, Arkansas, Texas, Iowa, the Dakotas, Minnesota, Montana, Colorado, and on the Pacific coast, the annual mean temperature was the highest ever reported. The following are some of the more notable departures of the mean temperature for the current year above the highest previous annual mean temperature: Boston, Mass., mean for 1889, 50°.7, 1°.3 above mean for 1880; New York City, mean for 1889, 53°.5, 0°.6 above mean for 1878; Fort Smith, Ark., mean for 1889, 61°.6, 0°.8 above mean for 1887; Saint Vincent, Minn., mean for 1889, 37°.3, 1°.8 above mean for 1881; Portland, Oregon, mean for 1889, 54°.8, 0°.5 above mean for 1885; San Francisco, Cal., mean for 1889, 57°.9, 0°.6 above mean for 1877; San Diego, Cal., mean for 1889, 62°.6, 0°.4 above mean for 1885.

The highest absolute maximum temperature reported by a regular station of the Signal Service was 117° at Yuma, Ariz., on July 3d, and the maximum temperature rose above 100° over a greater part of the plateau region south of the Columbia River, on the Pacific coast south of the fortieth parallel, save along the immediate coast line, and from eastern Montana and the Dakotas southward over the eastern slope of the Rocky Mountains to the Rio Grande Valley. East of the ninety-seventh meridian maximum temperatures of 100° or above were not reported by regular observers of the Signal Service, and the maximum readings were above 95° in a narrow belt running from the Red River of the North Valley to the west Gulf states, in the Atlantic states from central Virginia to northern Florida, and in the interior of the east Gulf states. The lowest maximum temperatures were noted on the coast of northern California, and in extreme eastern Massachusetts, where they fell to or below 80°, and the maximum readings were below 85° on the coast of Washington, and at coast stations in southeastern New England.

At Salt Lake City, Utah, the absolute maximum temperature, 102°, was the highest ever reported at that station, the highest previous maximum temperature, 101°, being noted in 1875. The highest absolute temperature ever reported by a regular station of the Signal Service was 119° at Fort McDowell, Ariz., in 1887.

The lowest absolute minimum temperature reported by a regular station of the Signal Service was —43°, at Saint Vincent, Minn., on February 23d; the minimum values were below —30° from Minnesota northwestward over North Dakota and northeastern Montana, and in northern Vermont; they were below —10° north of a line traced from southern Maine south of west over the lower lake region, the upper Mississippi and middle Missouri valleys to southern South Dakota, thence southwest to south-central Colorado, thence northwest to eastern Idaho, and thence northward over western Montana, and in an area in north-central Nevada; and were below zero north of a line traced from southern New England south of west to central Arizona, and east of this line continued northwestward to northwestern Nevada, and thence northward to the British Possessions north of extreme western Montana. The only sections in which the minimum temperature was above 32° (the freezing point) were Florida south of the thirtieth parallel, the Texas coast south of Galveston, the California coast south of the fortieth parallel, and in extreme southern California and southwestern Arizona.

No unprecedentedly low minimum temperatures were reported for the current year. The lowest absolute minimum temperature ever reported by a regular station of the Signal Service was —63°, at Poplar River, Mont., in 1885.

The greatest yearly ranges in temperature occurred in the Valley of the Red River of the North, and thence westward to Montana, where they exceeded 130°; they exceeded 100° north of a line traced from the middle New England coast south of west to central Arizona, and east of this line continued west of north to western Nevada, and thence northward over eastern Oregon and western and northern Idaho. The least yearly ranges in temperature occurred over extreme southern Florida, where they were less than 40°; along the middle Pacific coast they were less than 50°; and in Florida south of the thirtieth parallel, on the immediate west Gulf coast, and along the entire immediate Pacific coast they were less than 60°.

### ATMOSPHERIC PRESSURE.

The annual mean pressure was highest within an area which covered the east Gulf states, eastern Tennessee, and extreme northern Florida, where the mean readings rose to, or above, 30.10, and was lowest in the lower Colorado valley, where the mean values fell below 29.90. From the region of high pressure over the eastern part of the country there was a gradual decrease in pressure northward to the lower Saint Lawrence Valley, where it fell below 29.95, and from the region of low pressure over the western part of the southern plateau region the mean pressure increased eastward to the Atlantic coast, northward to the British Possessions, and westward to the Pacific coast.

The annual mean pressure was generally above the normal in the interior of the country, and was below the normal on the Pacific coast and adjoining parts of the plateau region, in the

Gulf States, except along the immediate coast, and at Atlantic coast stations between southern New England and Georgia. The most marked departures above the normal pressure were noted on the west coast of the Gulf of Saint Lawrence, and over the central part of the middle plateau region, where they equalled, or exceeded, .05, and the greatest departures below the normal pressure occurred on the Pacific coast, where they varied from .02 to .04.

The distribution of monthly mean pressure is of interest when considered in connection with the movements of low pressure storms and monthly precipitation. It has been found that marked departures from the usual distribution of monthly mean pressure cause the low pressure storms of the month to assume abnormal paths. In 1889 this result was noticeable in August and December when the pressure over the southeastern states was more than .10 above the normal, and no low pressure storms traversed the country east of the Mississippi River and south of the Ohio River, and in April when the pressure averaged more than .10 above the normal over the Canadian Maritime Provinces, and a large proportion of the low pressure storms passed southeastward from the Lake region and advanced over the Atlantic Ocean south of Nova Scotia, the normal course of storms in the latter-named regions being east or north of east from the Lake region. The great excess in rainfall in sections of the middle Atlantic states during the spring and summer months may also be attributed to an abnormal distribution of pressure, as during those months the pressure was unusually high between the coast of the United States and the Azores, which condition caused an inflow of vapor-laden southeast winds from the ocean over the coast districts, and also caused the storms of the north Atlantic to assume abnormal northerly paths.

## PRECIPITATION.

The heaviest yearly precipitation reported was one hundred and eleven inches, at Delta, Shasta Co., Cal., and the yearly precipitation exceeded seventy inches in areas in eastern and southeastern Pennsylvania, in southeastern Virginia, and at Neah Bay, Wash. Sixty inches, or more, of precipitation were reported over the eastern parts of the middle Atlantic states, in eastern North Carolina, on the immediate Pacific coast between the forty-third and forty-ninth parallels, in extreme northwestern California, and in eastern California between the thirty-eighth and thirty-ninth parallels. Within an area extending from north-central Nevada southward over Nevada, southeastern California, and southwestern Arizona the yearly precipitation was less than five inches, and it generally amounted to less than twenty inches in the Rocky Mountain and plateau regions, except in areas in northwestern Wyoming, northeastern Nevada, southwestern Colorado, and from central Arizona northward over adjoining parts of southwestern Utah and eastern Nevada, where it varied from twenty to nearly thirty inches.

The greatest excesses in precipitation for the year occurred over eastern and central Virginia and thence northward over the District of Columbia, central Maryland, and south-central Pennsylvania, where the average annual precipitation was exceeded by more than seventeen inches. The yearly precipitation was generally above the normal in the Atlantic states, except along the greater part of the immediate coast and in Florida; it was also above the normal on the Pacific coast south of the forty-first parallel, and within an area extending from the south Pacific coast northeastward over southern Nevada, western and northern Arizona, Utah, thence eastward to Nebraska and Kansas, and thence southward over central Texas. On the Pacific coast the greatest excesses in precipitation were noted along the California coast from San Francisco to Los Angeles, where the rainfall for the year was more than twelve inches greater than the annual average amount, and where at Los Angeles the excess for the year was nearly sixteen inches. In the central valleys the greatest excesses occurred in eastern Kansas, where they were more than eight inches, and where at Topeka the excess over the annual average was more than ten inches.

At a number of the regular stations of the Signal Service in the middle Atlantic states the annual precipitation was the heaviest ever reported, and a comparison of the records of the several stations shows the following absolute excesses in precipitation for 1889. At New York City the total precipitation, 58.68, was 3.34 greater than that of 1884; at Baltimore, Md. the total amount, 62.35, was 10.24 greater than that of 1886; at Washington City the total precipitation, 61.33, was 1.24 greater than that of 1878; at Lynchburgh, Va., the total precipitation, 60.58, was 3.30 greater than that of 1884; at Norfolk, Va., the total precipitation, 70.72, was 1.59 greater than that of 1877. On the extreme north Pacific coast the yearly precipitation is generally heavier than in any other section of the country, and at Neah Bay, Wash., where the annual precipitation averages 101.51, and amounted to 123.23 in 1886, the total rainfall for 1889 was but 79.83. At Tatoosh Island, Wash., where the annual average precipitation is 92.39, and where, in 1886, 112.47 fell, the rainfall for 1889 was 67.95. At Delta, Cal., where one hundred and eleven inches were reported for 1889, the yearly average rainfall is 44.23, and the greatest previous yearly precipitation, 53.54, was reported in 1885. On the middle and south Pacific coast the heaviest yearly precipitation occurred in 1884, when the precipitation of the current year was exceeded by amounts varying from 1.88 at San Francisco, Cal., to 11.56 at San Diego, Cal. In other sections of the country the years of occurrence of the heaviest precipitation varied. In New England the heaviest annual precipitation, 65.53, was reported at Boston, Mass., in 1878; in the middle Atlantic states the heaviest precipitation reported previous to the current year was 69.13, at Norfork, Va., in 1877; in the south Atlantic states 102.4 fell at Hatteras, N. C., in 1877; in the Gulf states 90.97 fell at Mobile, Ala., in 1881; in the Ohio valley and Tennessee 73.87 fell at Knoxville, Tenn., in 1875; in the Lake region 60.24 fell at Buffalo, N. Y., in 1878; in the upper Mississippi valley 61.58 fell at Cairo, Ill., in 1882; in the Missouri Valley 52.06 fell at Leavenworth, Kans., in 1877; in the extreme northwest 34.01 fell at Moorhead, Minn., in 1882; in the Rocky Mountain and plateau regions, 25.67 at Fort Assinniboine, Mont., in 1884; 23.64 at Salt Lake City, Utah, in 1875; 33.55 at Dodge City, Kans., in 1881; and 48.45 at Fort Sill, Tex., in 1877. At Red Bluff, Cal., the heaviest yearly precipitation, 48.96, occurred in 1878; at Sacramento, Cal., 34.92, in 1884; at San Francisco, Cal., 38.82, in 1884; at Los Angeles, Cal., 40.39, in 1884; at San Diego, Cal., 27.59, in 1884; and at Yuma, Ariz., 5.86, in 1884.

The greatest deficiencies in annual precipitation occurred in east-central Louisiana and west-central Washington, where the total precipitation was twenty inches, or more, less than the usual yearly amount. The precipitation for the year was also below the normal from the Pacific coast north of the forty-second parallel eastward to the upper lake region, and thence southward over the Mississippi Valley to the Gulf of Mexico; in Nevada, New Mexico, eastern Arizona, along the entire coast of the Gulf of Mexico, and at a majority of coast station from New Brunswick to Florida. The greatest deficiency noted on the Atlantic coast was 15.39 inches at Block Island, R. I. Chart vii, in showing the departures of the annual precipitation from the annual average precipitation, indicates the remarkable distribution of rainfall for the year. It will be seen that while the annual precipitation in the middle Atlantic states averaged about one-fourth greater than the average yearly amount of precipitation in that region, deficiencies occurred at middle Atlantic coast stations, and that but about 70 per cent. of the yearly average rainfall was reported at Block Island, R. I. On the south Pacific coast the precipitation was about two-thirds greater, and on the middle Pacific coast about one-third greater than usual, while on the north Pacific coast but about four-fifths of the annual average rainfall fell. In the west Gulf states there was an average deficiency of about 20 per cent., while within a limited